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CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD EFFECT OF THE INVENTION TECHNICAL
PROBLEM MEANS EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] While forming a field which presents other conductivity types to a 1 principal-plane side of a
semiconductor substrate which presents one conductivity type In a formation method of a solar battery
element which can be burned in an electrode material which forms an antireflection film in a 1 principal-plan
side of this semiconductor substrate, and changes from an organic vehicle and a glass frit to a principal
plane side of everything but said semiconductor substrate this antireflection film top in the end of silver dust
A formation method of a solar battery element that an electrode material which can be burned on said
antireflection film is characterized by containing any one sort in Ti, Bi, Co, Zn, Zr, Fe, and Cr component, or
two or more sorts.
[Claim 2] A formation method of a solar battery element according to claim 1 characterized by carrying out
0.05-5 weight section content of said Ti, Bi, Co, Zn, Zr and Fe, Cr powder, any one sort of the oxide powder,
or two or more sorts by metal conversion to the silver 100 weight section in said electrode material.
[Claim 3] Said Ti, Bi, Co, Zn, Zr and Fe, a formation method of a solar battery element according to claim 1
or 2 characterized by containing Cr component in a form of metal powder or oxide powder.
[Claim 4] A formation method of a solar battery element according to claim 3 characterized by mean particle
diameter of said metal powder or oxide powder being 0.1-5 micrometers.
[Claim 5] A formation method of a solar battery element according to claim 1 to 4 characterized by said
antireflection film consisting of a silicon nitride film.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] Especially this invention relates to the formation method of the solar battery element which can be burned and forms an electrode material in an antireflection film about the formation method of a solar battery element.
[0002]
[Description of the Prior Art] When forming a solar battery element using a silicon substrate, the surface is etched in order to defecate the cutting plane of a silicon substrate first.
[0003] Next, the electrode was formed by forming a silicon nitride film or a silicon oxide film etc. which has the thickness of about 850A as an antireflection film on a silicon substrate, removing the electrode formation section in this silicon nitride film or a silicon oxide film, printing the electrode material which uses as a principal component the silver made into the shape of a paste into this portion, and being burned on it at the temperature of about 600-900 degrees C. As this electrode material, the electrode material of the shape of a paste which consists of the organic vehicle of 10 - 30 weight section and the glass frit of 0.1 - 5 weight section etc. was used to the 100 weight sections in the end of silver dust it has the particle size of about 0.1-2 micrometers.
[0004] However, in case an activity becomes complicated, for example, a paste-like electrode material is printed in the electrode formation section of an antireflection film since there are many production processes when removing the electrode formation section of an antireflection film, and it can be burned and forms an electrode in this portion, strict alignment is needed, and if a location gap etc. arises, it will become the factor which reduces the yield. Moreover, expensive equipment of a printer, **** Rhine, etc. is needed also at the removal production process of the electrode formation section of an antireflection film.
[0005] The method which prints a paste-like electrode material on an antireflection film on the other hand, without removing the electrode formation section of an antireflection film, and can be burned as it is is also proposed. That is, melting also of the antireflection film material located in the lower part of that electrode material tends to be carried out, this electrode material and silicon substrate tend to be contacted, and it is going to acquire ohmic contact to this electrode material and silicon at the same time it carries out heating melting of the electrode material of the shape of a paste which carried out printing spreading on an antireflection film.
[0006] However, when a paste-like electrode material was printed on an antireflection film and it was able to be burned as it is, without removing the electrode formation section of an antireflection film, the stable ohmic contact was not acquired and what also has the bond strength of an electrode enough to bear a modularization was not obtained.
[0007] When this invention is made in view of such a conventional trouble, carries out printing spreading of the electrode material on an antireflection film and can be burned as it is, stable ohmic contact is not acquired but it aims at offering the formation method of a solar battery element that electrode reinforcement canceled the conventional trouble that it could not respond to a modularization weakly.
[0008]
[Means for Solving the Problem] In order to attain the above-mentioned purpose, while forming a field which presents other conductivity types to a 1 principal-plane side of a semiconductor substrate which presents one conductivity type according to a formation method of a solar battery element concerning this invention In a formation method of a solar battery element which can be burned in an electrode material which forms an antireflection film in a 1 principal-plane side of this semiconductor substrate, and changes from an organic vehicle and a glass frit to a principal plane side of everything but said semiconductor substrate this antireflection film top in the end of silver dust An electrode material which can be burned on said antireflection film is characterized by containing any one sort in Ti, Bi, Co, Zn, Zr, Fe, and Cr component, or two or more sorts.
[0009] It is desirable to carry out 0.05-5 weight section content of said Ti, Bi, Co, Zn, Zr and Fe, Cr powder, any one sort of the oxide powder, or two or more sorts by metal conversion to the silver 100 weight section in said electrode material by formation method of the above-mentioned solar battery element.
[0010] Moreover, it is desirable to contain said Ti, Bi, Co, Zn, Zr and Fe, and Cr component in a form of metal powder or oxide powder in a formation method of the above-mentioned solar battery element.
[0011] Moreover, it is desirable for mean particle diameter of said metal powder or oxide powder to be 0.1-5 micrometers by formation method of the above-mentioned solar battery element.
[0012] Moreover, it is desirable for said antireflection film to consist of a silicon nitride film by formation method of the above-mentioned solar battery element.

[0013]
[Embodiment of the Invention] Hereafter, this invention is explained to details based on an accompanying drawing. Drawing 1 is drawing showing the formation method of the solar battery element of this invention. First, the semiconductor substrate 1 is prepared (refer to drawing 1 (a)). This semiconductor substrate I consists of a single crystal or polycrystalline silicon. This silicon substrate I contains 1 conductivity-type semiconductor impurities, such as boron (B), 1x1016 - about three 1018 atoms/cm, and is an about specific resistance 1.5ohmcm] substrate. In the case of single crystal silicon, it is formed of the Czochralski method etc., and, in the case of polycrystalline silicon, is formed by casting etc. Polycrystalline silicon can be mass-produced and is more advantageous than single crystal silicon in respect of a manufacturing cost. The ingot formed by the Czochralski method or casting is sliced in thickness of about 300 micrometers, and it cuts in about [10cmx10cm] magnitude, and considers as a silicon substrate.
[0014] Next, in order to defecate the cutting plane of a substrate, minute amount etching of the surface is carried out very much with fluoric acid, a FUTSU nitric acid, etc.
[0015] Next, by arranging silicon substrate I all over a diffusion furnace, and heating in phosphorus oxychloride (POCl3) etc., field 1a which the surface portion of a wafer 1 is made to diffuse the Lynn atom, and sheet resistance presents other conductivity types of 30-300ohms / ** is formed, and semiconductor junction 3 is formed (refer to drawing 1 (b)).
[0016] Next, pure water washes, after leaving only field 1a which presents other conductivity types by the side of the 1 principal plane of a silicon substrate 1 and removing other portions (drawing 1 (c)). Removal of field 1a which presents other conductivity types other than a 1 principal-plane this silicon substrate 1 side is performed by removing a resist film, after applying a resist film to the 1 principal-plane side of a silicon substrate 1 and carrying out etching removal using the mixed liquor of fluoric acid and a nitric acid.
[0017] Next, an antireflection film 2 is formed in the 1 principal-plane side of a silicon substrate 1 (drawing 1 (d)). This antireflection film 2 is formed by the plasma-CVD method which consists of a silicon nitride film etc., for example, is made to plasma-ize the mixed gas of a silane (SiH4) and ammonia (NH4) by glow discharge decomposition, and is made to deposit. In consideration of a refractive-index difference with a silicon substrate 1 etc., this antireflection film 2 is formed so that a refractive index may become 1.8 to about 2.3, and it is formed in thickness with a thickness of about 500-1000A. This silicon nitride film has the PASSHI bait effect in the case of formation, and is effective in combining with an acid-resisting function and raising the electrical property of a solar battery.
[0018] Next, after applying the rear-face electrode material 4 and drying, the surface electrode material 5 is applied and it dries (drawing 1 (e)). These electrode materials 4 and 5 print with screen printing what added 10 - 30 weight section and 0.1 - 5 weight section to the silver 100 weight section, respectively, and made silver, the organic vehicle, and the glass frit the shape of ** 1 strike, and can be burned by calcinating about 1 to 30 minutes at 600-800 degrees C.
[0019] In this case, the organic vehicle used is resin used in order to make a powder-like thing into the shape of a paste, for example, has a cellulose system and an acrylic thing. Since it decomposes and these vaporize at about 400 degrees C, the component does not remain in the electrode after baking. Moreover, a glass frit is used in order to give reinforcement to the electrode which was able to be burned. Although a glass frit has a thing with about 300-600-degree C various softening temperatures including lead, boron, silicon, etc., a part remains into an electrode after baking, and a part has the function to paste up between an electrode and a silicon substrate, in order to act on silicon.
[0020] As for this electrode material 5, it is desirable to carry out 0.05-5 weight section content of any one of Ti, Bi, Co, Zn, Zr, Fe, and the Cr components or two or more to the silver 100 weight section. These components contain these during a paste in the form of a depositable organometallic compound by metal powder, oxide powder, or baking.
[0021] Said component acts on a glass frit during baking, and the part melts. Then, this mixture acts on a silicon nitride film or a silicon oxide film. This operation reacts more stably compared with the time of said component not containing, and, as a result, raises contact nature and bond strength.
[0022] Reinforcement with this content of Ti, Bi, Co, Zn, Zr, Fe, and Cr sufficient in below the 0.05 weight section is not obtained. Moreover, line resistance of an electrode material increases above 5 weight sections.
[0023] When blending these components in the form of powder, such as metal powder and oxide powder, it is desirable to use the thing of the range whose mean particle diameter is 0.1-5 micrometers. When the mean particle diameter of this powder is 0.1 micrometers or less, the dispersibility in the inside of an electrode material worsens, and sufficient bond strength (tensile strength) of an electrode cannot be obtained. When mean particle diameter is 5 micrometers or more, screen-stencil nature (homogeneity of a line piece and line breadth) worsens, and cannot obtain sufficient bond strength of an electrode. In addition, although the mean particle diameter in this case is defined by a laser diffraction scattering method, a light transmission type centrifuge, a sound method, the diffusion method, etc., in any case, it is applied.
[0024] in addition -- although the rear-face electrode material 4 does not need to be the same material as an electrode material 5, if Ti, Bi, Co, Zn, Zr, Fe, and Cr component are made it to **** -- bond strength -- large -- ** -- it is desirable at **.
[0025] Moreover, this rear-face electrode 4 and surface electrode 5 are covered with solder etc. if needed.
[0026] In addition, before forming the rear-face electrode 4, the BSF layer which diffused aluminum may be formed in other principal plane side of a silicon substrate 1.
[0027]
[Example] Specific resistance diffused P three times 1x1017 atoms/cm, and formed the silicon nitride film

with a thickness of 850A in the 1 principal-plane side of the silicon substrate which is 1.5-ohmcm as an antireflection film. Then, the silver paste which does not add said powder, and the paste which contains the 0.04 weight section – 5.5 weight section for titanium oxide powder with a mean particle diameter of 1 micrometer by metal conversion to the silver 100 weight section could be burned at 700 degrees C, and the electrical property of a solar battery element and the reinforcement of the polar zone were measured. Similarly the paste which contains the 0.04 weight section – 5.5 weight section for each powder of a bismuth oxide with a mean particle diameter of 1 micrometer, cobalt oxide, a zinc oxide, zirconium oxide, an iron oxide, and chrome oxide by metal conversion to the silver 100 weight section could be burned at 700 degrees C, and the electrical property (current reinforcement, open circuit voltage, a curvilinear factor, conversion efficiency) of a solar battery element and the tensile strength of the polar zone were measured. Strong measurement attached copper foil in the polar zone with solder, and when it pulled up this perpendicularly, it saw weight until copper foil separates or a cel is destroyed. The result is shown in a table 1. Moreover, when that whose mean particle diameter of said powder or oxide powder is 0.05 micrometers about the same experiment was used, sufficient reinforcement was not obtained irrespective of the content. When the mean particle diameter of said powder or oxide powder exceeded 5 micrometers, irrespective of the content, on the occasion of screen-stencil, many line pieces were generated and sufficient electrical property was not acquired.

[0028]
[A table 1]

反射防止膜：窒化シリコン（酸化物添加）

No	添加物	添加量 対銀100重量部	電流密度 (mA/cm2)	開放電圧 (mV)	曲線因子	変換効率 %	引張強度 kg	強度判定
1	なし	―	30.41	590.4	0.735	13.20	0.15	×
2a	酸化チタン	0.04	30.42	590.1	0.738	13.25	0.18	×
2b	酸化チタン	0.05	30.41	590.1	0.739	13.26	0.22	○
2c	酸化チタン	0.10	30.48	590.0	0.750	13.49	0.52	◎
2d	酸化チタン	0.20	30.33	591.0	0.752	13.48	0.68	◎
2e	酸化チタン	5.00	30.36	590.2	0.740	13.26	0.60	◎
2f	酸化チタン	5.50	30.39	590.2	0.725	13.00	0.52	◎
3a	酸化ビスマス	0.04	30.40	590.0	0.737	13.22	0.17	×
3b	酸化ビスマス	0.05	30.42	590.0	0.74	13.28	0.20	○
3c	酸化ビスマス	0.10	30.48	589.9	0.738	13.27	0.41	◎
3d	酸化ビスマス	5.00	30.40	589.9	0.735	13.18	0.35	○
3e	酸化ビスマス	5.50	30.39	590.2	0.729	13.08	0.38	○
4a	酸化コバルト	0.04	30.42	589.9	0.738	13.21	0.16	×
4b	酸化コバルト	0.05	30.43	590.0	0.740	13.29	0.23	○
4c	酸化コバルト	0.10	30.46	589.4	0.753	13.52	0.35	○
4d	酸化コバルト	5.00	30.46	589.4	0.745	13.38	0.33	○
4e	酸化コバルト	5.50	30.38	590.1	0.721	12.93	0.38	○
5a	酸化亜鉛	0.04	30.41	589.7	0.740	13.27	0.19	×
5b	酸化亜鉛	0.05	30.42	590.2	0.745	13.38	0.25	○
5c	酸化亜鉛	0.10	30.35	590.1	0.756	13.54	0.39	○
5d	酸化亜鉛	5.00	30.35	590.1	0.742	13.29	0.33	○
5e	酸化亜鉛	5.50	30.38	589.9	0.724	12.97	0.32	○
6a	酸化ジルコニウム	0.04	30.39	590.2	0.728	13.06	0.15	×
6b	酸化ジルコニウム	0.05	30.38	590.2	0.734	13.16	0.20	○
6c	酸化ジルコニウム	0.10	30.42	589.2	0.745	13.35	0.30	○
6d	酸化ジルコニウム	5.00	30.40	590.0	0.740	13.27	0.31	○
6e	酸化ジルコニウム	5.50	30.41	590.3	0.729	13.09	0.28	○
7a	酸化鉄	0.04	30.40	589.9	0.736	13.20	0.18	×
7b	酸化鉄	0.05	30.40	590.1	0.738	13.24	0.22	○
7c	酸化鉄	0.10	30.38	590.0	0.742	13.30	0.25	○
7e	酸化鉄	5.00	30.39	590.0	0.735	13.18	0.28	○
7d	酸化鉄	5.50	30.39	590.3	0.725	13.01	0.30	○
8a	酸化クロム	0.04	30.41	590.1	0.738	13.24	0.17	×
8b	酸化クロム	0.05	30.41	590.1	0.738	13.24	0.27	○
8c	酸化クロム	0.10	30.45	589.6	0.748	13.43	0.33	○
8e	酸化クロム	5.00	30.42	590.1	0.735	13.19	0.30	○
8d	酸化クロム	5.50	30.42	589.9	0.723	12.97	0.31	○

＊強度判定（良 ←◎－○－×→ 悪）

[0029] The improvement in electrode reinforcement and an improvement of ohmic contact were found by

content of each of said powder. As shown in a table 1, the tensile strength without content was 0.15kg, and the electrical property was 13.20%. In the 0.05 – 5.00 weight section of titanium oxide powder, tensile strength was 0.22-0.68kg, and the electrical property (conversion efficiency) was 13.26 – 13.49%. In the 0.05 – 5.00 weight section of bismuth-oxide powder, tensile strength was 0.20-0.41kg, and the electrical property was 13.18 – 13.28%. In the 0.05 – 5.00 weight section of cobalt oxide powder, tensile strength was 0.23-0.35kg, and the electrical property was 13.29 – 13.52%. In the 0.05 – 5.00 weight section of zinc-oxide powder, tensile strength was 0.24-0.39kg, and the electrical property was 13.29 – 13.54%. In the 0.05 – 5.00 weight section of zirconium oxide powder, tensile strength was 0.20-0.31kg, and the electrical property was 13.16 – 13.35%. In the 0.05 – 5.00 weight section of iron oxide powder, tensile strength was 0.22-0.28kg, and the electrical property was 13.18 – 13.30%. In the 0.05 – 5.00 weight section of chrome oxide powder, tensile strength was 0.27-0.33kg, and the electrical property was 13.19 – 13.43%. From this result, the contact nature (curvilinear factor) of an electrical property is stabilized, and what also has the bond strength of an electrode enough to bear a modularization came to be obtained.

[0030] Moreover, when the mean particle diameter of each powder exceeded 5 micrometers, at the time of printing, the line piece was generated and a stable electrical property was not able to be acquired. Moreover, it also checked that reinforcement sufficient in content of the 0.04 weight sections was not obtained. Furthermore, in content of the 5.5 weight sections, line resistance increased and it checked that a curvilinear factor fell.

[0031] Moreover, the antireflection film followed that said whose powder is not an oxide with the silicon nitride film in the same experiment. The result is shown in a table 2.

[0032]
[A table 2]
反射防止膜：窒化シリコン（酸化物以外添加）

No	添加物	添加量 対銀100重量部	電流密度 (mA/cm2)	開放電圧 (mV)	曲線因子	実換効率 %	引張強度 kg	強度判定
1a	チタン	0.04	30.41	590.3	0.738	13.25	0.15	×
1b	チタン	0.05	30.39	590.3	0.740	13.28	0.21	○
1c	チタン	0.10	30.40	590.2	0.748	13.42	0.39	○
1d	チタン	5.00	30.41	590.0	0.739	13.26	0.35	○
1e	チタン	5.50	30.42	589.2	0.726	13.01	0.38	○
2a	ビスマス	0.04	30.39	590.3	0.736	13.20	0.12	×
2b	ビスマス	0.05	30.39	590.2	0.740	13.27	0.22	○
2c	ビスマス	0.10	30.42	590.6	0.745	13.38	0.35	○
2d	ビスマス	5.00	30.39	590.2	0.740	13.27	0.33	○
2e	ビスマス	5.50	30.40	590.4	0.728	13.07	0.37	○
3a	コバルト	0.04	30.41	590.1	0.739	13.28	0.18	×
3b	コバルト	0.05	30.41	590.3	0.742	13.32	0.25	○
3c	コバルト	0.10	30.46	590.4	0.750	13.49	0.37	○
3d	コバルト	5.00	30.42	590.2	0.739	13.27	0.36	○
3e	コバルト	5.50	30.39	590.5	0.724	12.99	0.33	○
4a	亜鉛	0.04	30.41	590.3	0.740	13.28	0.16	×
4b	亜鉛	0.05	30.41	590.3	0.742	13.32	0.22	○
4c	亜鉛	0.10	30.38	590.1	0.755	13.54	0.29	○
4d	亜鉛	5.00	30.39	589.9	0.738	13.23	0.30	○
4e	亜鉛	5.50	30.39	590.1	0.729	13.07	0.32	○
5a	ジルコニウム	0.04	30.42	590.4	0.731	13.13	0.18	×
5b	ジルコニウム	0.05	30.45	590.4	0.738	13.27	0.22	○
5c	ジルコニウム	0.10	30.44	589.9	0.741	13.31	0.28	○
5d	ジルコニウム	5.00	30.42	589.8	0.740	13.28	0.25	○
5e	ジルコニウム	5.50	30.45	589.7	0.728	13.07	0.26	○
6a	鉄	0.04	30.39	590.2	0.739	13.25	0.17	×
6b	鉄	0.05	30.39	590.0	0.741	13.29	0.20	○
6c	鉄	0.10	30.45	589.5	0.742	13.32	0.25	○
6d	鉄	5.00	30.42	590.1	0.735	13.19	0.24	○
6e	鉄	5.50	30.43	589.9	0.725	13.01	0.24	○
7a	クロム	0.04	30.40	590.2	0.736	13.21	0.19	×
7b	クロム	0.05	30.40	590.2	0.736	13.21	0.21	○
7c	クロム	0.10	30.39	588.5	0.740	13.23	0.33	○
7d	クロム	5.00	30.39	589.9	0.734	13.18	0.28	○
7e	クロム	5.50	30.41	590.1	0.726	13.03	0.29	○

[0033] It checked becoming the same orientation as a table 1.
[0034] Furthermore, when an antireflection film was a silicon oxide film about the same experiment, the

experiment when not being the case where said powder is an oxide, and an oxide was conducted. The result is shown in a table 3 and a table 4.
[0035]
[A table 3]

反射防止膜：酸化シリコン（酸化物添加）

No	添加物	添加量 対銀100重量部	電流密度 (mA/cm2)	開放電圧 (mV)	曲線因子	変換効率 %	引張強度 kg	強度判定
1	なし	–	29.28	582.1	0.725	12.36	0.14	×
2a	酸化チタン	0.04	29.30	581.5	0.732	12.47	0.18	×
2b	酸化チタン	0.05	29.30	582.0	0.74	12.62	0.29	○
2c	酸化チタン	0.10	29.31	582.1	0.748	12.76	0.46	◎
2d	酸化チタン	5.00	29.31	582.1	0.748	12.76	0.40	◎
2e	酸化チタン	5.50	29.29	582.3	0.728	12.42	0.38	○
3a	酸化ビスマス	0.04	29.31	581.6	0.731	12.46	0.15	×
3b	酸化ビスマス	0.05	29.30	582.2	0.732	12.49	0.23	○
3c	酸化ビスマス	0.10	29.30	582.2	0.738	12.59	0.39	○
3d	酸化ビスマス	5.00	29.32	581.9	0.731	12.47	0.36	○
3e	酸化ビスマス	5.50	29.19	582.3	0.725	12.32	0.35	○
4a	酸化コバルト	0.04	29.30	582.5	0.725	12.37	0.14	×
4b	酸化コバルト	0.05	29.25	581.8	0.734	12.49	0.25	○
4c	酸化コバルト	0.10	29.18	581.5	0.735	12.47	0.41	◎
4d	酸化コバルト	5.00	28.26	581.6	0.732	12.03	0.41	◎
4e	酸化コバルト	5.50	29.24	581.9	0.718	12.22	0.36	○
5a	酸化亜鉛	0.04	29.26	582.0	0.730	12.43	0.13	×
5b	酸化亜鉛	0.05	29.30	582.5	0.738	12.60	0.26	○
5c	酸化亜鉛	0.10	29.33	582.3	0.741	12.66	0.32	○
5d	酸化亜鉛	5.00	29.28	582.0	0.739	12.59	0.31	○
5e	酸化亜鉛	5.50	29.25	581.9	0.721	12.27	0.33	○
6a	酸化ジルコニウム	0.04	29.31	581.8	0.729	12.43	0.19	×
6b	酸化ジルコニウム	0.05	29.29	581.7	0.736	12.54	0.23	○
6c	酸化ジルコニウム	0.10	29.28	581.9	0.742	12.63	0.39	○
6d	酸化ジルコニウム	5.00	29.31	582.1	0.732	12.49	0.32	○
6e	酸化ジルコニウム	5.50	29.33	582.3	0.719	12.28	0.35	○
7a	酸化鉄	0.04	29.30	582.0	0.738	12.58	0.15	×
7b	酸化鉄	0.05	29.30	582.0	0.738	12.58	0.22	○
7c	酸化鉄	0.10	29.30	582.0	0.738	12.58	0.32	○
7d	酸化鉄	5.00	29.30	582.0	0.738	12.58	1.32	○
7e	酸化鉄	5.50	29.18	581.9	0.723	12.28	0.31	○
8a	酸化クロム	0.04	29.28	581.7	0.728	12.39	0.16	×
8b	酸化クロム	0.05	29.40	582.1	0.738	12.63	0.26	○
8c	酸化クロム	0.10	29.31	581.6	0.741	12.63	0.37	○
8d	酸化クロム	5.00	29.31	581.6	0.741	12.63	0.35	○
8e	酸化クロム	5.50	29.29	582.0	0.720	12.27	0.33	○

＊強度判定（良 ←◎－○－×→ 悪）

[0036] It checked becoming the same orientation as a table 1.
[0037]
[A table 4]

反射防止膜：酸化シリコン（酸化物以外添加）

No	添加物	添加量 対銀100重量部	電流密度 (mA/cm2)	開放電圧 (mV)	曲線因子	変換効率 %	引張強度 kg	強度判定
1a	チタン	0.04	29.22	582.1	0.728	12.38	0.15	×
1b	チタン	0.05	29.23	582.0	0.738	12.55	0.24	○
1c	チタン	0.10	29.23	581.6	0.742	12.61	0.38	○
1d	チタン	5.00	29.28	581.7	0.735	12.52	0.35	○
1e	チタン	5.50	29.30	581.9	0.705	12.02	0.33	○
2a	ビスマス	0.04	29.29	583.0	0.729	12.45	0.19	×
2b	ビスマス	0.05	29.33	582.5	0.738	12.61	0.23	○
2c	ビスマス	0.10	29.33	582.3	0.745	12.72	0.30	○
2d	ビスマス	5.00	29.33	582.4	0.732	12.50	0.33	○
2e	ビスマス	5.50	29.19	582.1	0.716	12.17	0.34	○
3a	コバルト	0.04	29.28	581.6	0.725	12.35	0.17	×
3b	コバルト	0.05	29.25	582.0	0.735	12.51	0.20	○
3c	コバルト	0.10	29.25	582.1	0.739	12.58	0.28	○
3d	コバルト	5.00	29.25	582.3	0.732	12.47	0.29	○
3e	コバルト	5.50	29.31	582.1	0.714	12.18	0.29	○
4a	亜鉛	0.04	29.27	581.6	0.726	12.36	0.16	×
4b	亜鉛	0.05	29.27	582.1	0.740	12.61	0.21	○
4c	亜鉛	0.10	29.29	582.0	0.746	12.72	0.37	○
4d	亜鉛	5.00	29.31	581.9	0.731	12.47	0.32	○
4e	亜鉛	5.50	29.34	580.9	0.709	12.08	0.32	○
5a	ジルコニウム	0.04	29.21	582.0	0.728	12.38	0.19	×
5b	ジルコニウム	0.05	29.31	582.0	0.732	12.49	0.23	○
5c	ジルコニウム	0.10	29.24	581.7	0.738	12.55	0.35	○
5d	ジルコニウム	5.00	29.23	581.9	0.734	12.48	0.32	○
5e	ジルコニウム	5.50	29.30	581.9	0.715	12.19	0.28	○
6a	鉄	0.04	29.19	582.0	0.726	12.33	0.14	×
6b	鉄	0.05	29.31	582.2	0.738	12.59	0.20	○
6c	鉄	0.10	29.30	582.6	0.740	12.63	0.29	○
6d	鉄	5.00	29.32	582.3	0.730	12.46	0.29	○
6e	鉄	5.50	29.28	582.4	0.712	12.14	0.31	○
7a	クロム	0.04	29.31	581.5	0.729	12.42	0.16	×
7b	クロム	0.05	29.29	581.2	0.735	12.51	0.21	○
7c	クロム	0.10	29.30	580.9	0.738	12.56	0.32	○
7d	クロム	5.00	29.29	581.2	0.725	12.34	0.33	○
7e	クロム	5.50	29.25	582.0	0.703	11.97	0.36	○

[0038] It checked becoming the same orientation as a table 1.
[0039]
[Effect of the Invention] As mentioned above, according to the formation method of the solar battery element concerning this invention, since an electrode material contains any one sort in Ti, Bi, Co, Zn, Zr, Fe, and Cr component, or two or more sorts, even if it applies this electrode material from an antireflection film and can be burned, ohmic KONNTAKUTO nature (curvilinear factor) is good, and a solar battery element with strong tensile strength is obtained.
[0040]

[Translation done.]

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is drawing for explaining the formation method of the solar battery element concerning this invention, and (a) - (e) is a cross section for every production process.
[Description of Notations]
1: A silicon substrate, the field which has a 1a:reverse conductivity-type semiconductor impurity,
2:antireflection film, 4:rear-face electrode, 5 : surface electrode

[Translation done.]